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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 21 Number 1

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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CALIFORNIA HELITACK REPORT—1958

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Pacific Southwest Forest and Range Experiment Station

Many questions about Helitack required answering at the beginning of the 1958 fire season. This was the 12th year helicopters had been used in fire control in California. It was the third year of the Helitack Project, the cooperative research and development program aimed at integrating the helicopter into fire control.[2] Helicopter accessories such as the hose dispensing tray and the 40-gallon helitank had been developed through Helitack. Over 400 forest firemen had been trained in "Helitactics" throughout the State. What were the results of this intensive program to be? Would unforeseen problems render many of the techniques impractical? And what about large helicopters—would they soon replace the small ones? To determine some of the answers to these questions, evaluation report forms were distributed to all units using helicopters throughout California.

During 1958, nine national forests in California had helicopters on permanent standby at a base heliport within the forest. Six additional forests had agreements with helicopter contractors who guaranteed helicopter service when ordered. The remaining two forests were able to order helicopters for fire projects when needed by requesting them through their zone dispatcher.

California State Division of Forestry districts had "on call" agreements with several helicopter contractors, sharing the service of a helicopter with adjacent national forests in several cases. The Los Angeles County Fire Department owned and operated three Bell G-2 helicopters out of their base heliport in Los Angeles.

Fire control projects constituted the majority of helicopter use in California during 1958. During periods of low fire danger, the helicopter was used for various nonfire projects, such as manning and supplying lookouts, road location, telephone pole setting, timber cruising, and game surveys.

"HELITACK" USE ON FOREST FIRES

Helicopters were used on a reported 60 forest fires in California in 1958. They were used for many of the same types of jobs they performed 10 years before, but many more jobs were new ones.

Helitack crews.—Helitack crews made initial attack on a reported 32 fires throughout the State. The crews made helijumps on 15 of the fires. The helicopter was able to land on the other 17. The crews' average elapsed travel time to these fires was 35 minutes. Ground crew travel time to the same fires averaged 5 hours and 42 minutes.

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[1]This report was prepared under terms of a cooperative student-aid agreement between Utah State University and the Experiment Station.

[2]Helitack: A cooperative program between the U. S. Forest Service, the U. S. Army, and the California State Division of Forestry.

The crews performed specialized jobs on large fires. They functioned as base heliport managers on 21 large fires, loading and unloading personnel and cargo and managing the installation and use of helicopter accessories. Helitack crews constructed 19 helispots on 15 fires to ferry large crews to remote sectors of the fireline. On the majority of these fires, the crews had to helijump to the ground to construct the helispots. On seven large fires, helicopters and Helitack crews made initial attack on slopovers, blowups, and spots in areas where immediate action was necessary and ground crews were not available.

Reconnaissance.—A total of 575 reconnaissance missions were made on the reported fires in 1958. The old argument of fixed-wing aircraft versus helicopter for reconnaissance was renewed by many units who reported that the slow flying speed of the helicopter, coupled with its maneuverability and ability to fly close to the ground make it possible to make detailed observations whose value could not be matched from fixed-wing aircraft.

Helicopters helped to locate seven fires in areas unseen by fixed lookouts and guided the ground crews to the fire area.

Law enforcement was handled by helicopter reconnaissance personnel on two fires when a suspected firebug was spotted, chased, and the car license reported to apprehending police on the ground.

The helicopter functioned as a "bird dog" ship on seven fires, leading retardant-carrying air tankers to the fire and directing the drops.

Ferry missions.—Helicopters ferried 1,616 firemen and 53,112 pounds of cargo on the 60 fires reported. Helispots constructed by Helitack crews made it possible to place many of these men in remote areas which would take hours of hiking time to reach. Use of the electrically released bomb shackle assembly[3] allowed more cargo to be carried in a safer manner than previously used methods. Much of the cargo was dropped by parachute using the new paracargo rig developed by the Arcadia Equipment Development Center.

Helitank drops.—Foresters reported that 186 water and retardant drops were made by helicopters during the season. They also reported that over 75 percent of the drops made with the 40-gallon helitank were instrumental in retarding or suppressing spot fires and flareups in areas where ground crews and air tankers were not available. On three fires on the Angeles National Forest, helitanks were credited with being the most important factor in suppressing spot fires which threatened the loss of critical portions of the firelines.

Hoselays.—More than 15,000 feet of fire hose were laid by helicopter on wildfires in 1958. Probably the longest helicopter hoselay yet completed on a forest fire in the United States was made on the Monrovia fire by the combined Helitack crews of the Angeles Forest and the Los Angeles County Fire Department. Ten

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[3]Arcadia Equipment Development Center. *Fire Accessories for the Light Helicopter.* Fire Control Notes 19:82-87, illus. 1958.

thousand feet of 1½-inch hose was laid in 20 consecutive trips over rugged terrain to aid control of one critical sector of the fire.

Other fire jobs.—Injured firemen were evacuated from remote fire areas by helicopters on two fires and backfiring operations were carried out by dropping lighted fusees from the helicopter on several others.

TRENDS IN HELITACK

Helitack reinforcement crews.—Although the Helitack crew functioned during large fires and on fire concentrations, such as "lightning busts," they could not handle the entire Helitack operation. To maintain the flexibility of the operation, ground crews were trained in helitactics, including safety, and were called on to function as reinforcement crews when necessary. These trained reinforcement crews were extremely valuable on large fires when the regular Helitack crew was engaged in performing specialized jobs on the fireline. They acted principally as service crews, managing helicopter operations at the base heliports.

Integration of conventional ground crews into the Helitack operation was the result of another important fact demonstrated during the 1958 fire season: Helitack cannot replace the ground fire suppression organization. On several fires high winds in the early stages made air attack impossible. The ground crews had to do the job; Helitack, then had to be an additional tool, a supplement to the existing organization.

Cooperation between agencies.—One of the highlights of the 1958 fire season was the close cooperation between the air units of the various fire agencies. On one project fire a Forest Service Helitack crew combined operations with the Los Angeles County helicopter unit to control a critical portion of the fire. The Helitack crew jumped to a potential helispot location in a remote area and constructed a helispot. The fire spread was slowed by nearly 40 helitank drops of water until the helicopters could ferry in a 25-man crew to construct the fire control line. The entire operation was completed in less than an hour.

Top pilots emerge.—One significant factor was obvious in 1958: The outstanding pilots were those who had returned to the same forest for the second or third year. The pilot's knowledge of the country and its flying conditions and his experience on fires proved to be invaluable in the efficiency and safety of the operation.

Air control problems.—Nearly every unit reporting declared air control a major problem. Project fires, on which several helicopters were operating along with air tankers and other fixed-wing aircraft, presented the biggest control problem. Most units declared dependable radio communications on all aircraft to be the only good answer. Others stated that radio congestion on ground frequencies made a separate air net vitally necessary.

To reduce radio congestion, one Helitack crew used preorganized initial attack plans, each plan designated by a letter. Plan A was a 100 percent jump operation; Plan B, jump and Helitank

drop alternated, etc. By radioing the plan letter and fire location back to the base heliport, the operation could be carried out with a minimum of radio traffic.

New helicopters.—A new helicopter, the French "Allouette," joined the Bells and Hillers that have been used for several years. Only one Allouette was available in California in 1958, but it demonstrated its ability to out-perform other ships, especially in transporting bigger payloads in less time and at higher operating density altitudes.

The Klamath National Forest credited the Allouette with playing a leading role in helping to avert what otherwise could have been a major conflagration. Eight men were transported in two quick trips to an isolated fire at an elevation of over 6 thousand feet. With the additional help of an air tanker drop these eight men were barely able to contain a fast spreading fire. Fewer men delivered over a longer period of time by a less capable helicopter would not have done the job.

WHAT ABOUT LARGE HELICOPTERS?

Because of commercial availability, only small helicopters were used in Helitack operations in California in 1958. However, to plan for the future, each helicopter evaluation form included the question, "Would a large helicopter have been more effective?" Thirty-two answers were received, 26 of them stating the opinion that the large helicopter would not have been more effective. The reasons almost unanimously given were (1) limited landing area made it impossible for the large helicopter to land anywhere near the project; (2) high elevations and turbulent conditions made it unsafe to attempt large helicopter operation. Several forests reported that the small helicopter was able to transport enough men to do the job and that a larger helicopter would not have been necessary.

The six affirmative reports thought that larger helicopters could have delivered "more men" or "more retardant" over a given unit of time and would have been desirable.

Helijumper Protective Suit

A helijumper protective suit has been developed by the Missoula Equipment Development Center. It is designed to protect firefighters from brush, trees, rocks, etc., when jumping from helicopters at a height of about 6 feet. The

suit is covered by U. S. Forest Service Specification 5100-176. Specifications and price information are obtainable from the U. S. Forest Service, Federal Building, Missoula, Mont.—ARTHUR W. JENSEN, *Forester, Division of Fire Control, U. S. Forest Service.*

DO SMOKERS REALLY CAUSE ALL SMOKER FIRES?

E. S. Bliss
Forester, Region 3, U. S. Forest Service

In the Southwestern Region of the Forest Service, which includes Arizona, New Mexico, and western Texas and Oklahoma, smokers and smoking are cataloged as causing the largest number of man-caused fires. About 140 fires on the average are listed each year as smoker fires. This is roughly 45 percent of all man-caused fires. Detailed information in most fire reports on smoker fires lists cigarette butts as the proximate cause. Most foresters think the discarded, burning cigarette is the villain too many times when it is often an accomplice. The smoker category has become a "catch all" for fires of uncertain origin.

Efforts at fire prevention are falling short of the results that we should obtain because we are overlooking other causative agents perhaps more potent than the ever-present butt, and possibly even greater than the smoker.

It is common knowledge that cigarette and cigar butts start fires only under limited conditions. A large number of tests have been made in a casual way, but they all lead to the same conclusions:

1. A burning cigarette or cigar butt in contact with rotten wood or dry duff will often ignite them especially if there is a breeze.

2. A burning cigarette in dense, dry grass at the base of a grass clump may, if there is a breeze, cause ignition but only if the grass is very dry and slightly decomposed.

If the cigarette and cigar butts are not the villains in the fire drama that they are thought to be, then who are the other rascals? Who except smokers are starting smoker fires? What causes all of our smoker fires? Here are some causes seldom listed.

Matches.—People who have learned to break their matches sometimes get their finger burned. In bright sunlight the flame on a burning match is difficult to see, and if the match stem and the air are dry, difficult to blow out. Many people over forty-five and without their glasses see a match at arm's length only as a blur. Just because the paper safety match appears so innocent, it is especially dangerous. Few people break them as they do wooden matches.

Besides lighting tobacco, people do many other things with matches. If a person suspected of starting a fire does not smoke, he should not for that reason be ruled out; he may have struck a match for some other purpose. People strike matches for light to look under car seats, into batteries and radiators, (and occasionally gas tanks), at oil measuring rods, and to ignite tire repair patches. They light matches to sterilize pins, needles, and knife blades. They light matches to burn insects and seeds stuck to their

clothing. They light matches to sear and stiffen the ends of thongs and laces. They strike matches for children to blow out. These are but a few of the common uses of matches not often considered.

We need a campaign to reduce careless use of matches. The old slogan "Break your match before throwing it away" is good but better is "Break your match then spit on it" or "Put your match in your ashtray or tramp into bare earth." A large number of grass fires and fires that start in light fuels could be prevented by extinguishing matches.

Lighters.—There are many kinds and makes of lighters—some good and some bad. The good ones appear to be safer in the woods than matches. Some of the bad ones spray or drip flaming fuel like a drip torch. These may be overcharged or leaky. Their use in the forest is about as dangerous as the use of a torch would be. City fire department officers confirm our view that some lighters are very dangerous.

A study is needed of lighters and their uses. If the dangerous ones are of a certain brand, this could be corrected by legal action if more expedient methods failed.

The Curious Incendiary.—Some fires are started by people who are curious to "see if it will burn." Not all are children, and the number is greater than we suspect. Some of these fires get into the smoker category because investigators are hesitant to believe that full-grown men and women will start fires for no apparent reason except to find out whether a clump of grass or pile of leaves will burn. Psychologists call it compulsion among other names. Probably most of us have felt the urge at one time or another. We should recognize that it is not an uncommon trait in the human race.

There is not much that we can do about our "fire bugs" except to learn who they are and put them out of harm's way whenever possible and for as long as possible.

There are many other causes of fires that sometimes are classified as smoker fires. They include backfiring of automobiles, shooting tracer bullets, homemade rockets, missiles, and fireworks. Only by examining the evidence on each fire critically will we learn more about causes than we know now, and thus be better able to prevent them.

THE CHEROKEE INCIDENT

[Extracted from a report by District Ranger L. C. Nix, Tellico Ranger District, Cherokee National Forest, Southern Region.]

The incendiary Tobe Creek fire occurred April 7, 1959, under extreme high fire danger conditions and burned 412 acres before it was controlled at 4:25 a.m. the following day. The incident took place between 10:00 and 10:30 p.m.

Conditions on and adjacent to the fire area required that extreme caution be exercised in planning the attack. The following factors were considered:

1. The area is rugged mountain terrain. Slopes vary from 40 to 75 percent.
2. Burning conditions were critical.
3. This same area burned in 1953. Prior to this, it was heavily stocked with sapling-, pole-, and sawtimber-size yellow pine. Most of the timber was killed and since has fallen. This left the area covered with a thick blanket of pine seedlings, hardwood sprouts, and highly flammable down and dead material.
4. Shifting 15–25 miles per hour winds.
5. Time of day—midafternoon.
6. Weather forecast.

The first set of the Tobe Creek fire was discovered at 2:35 p.m. and the second set at 2:50. At 2:52 Forestry Aid Beecher Colvin and six men were dispatched to the first set. At 3:00 Forestry Aid Onus Thompson and a five-man crew were dispatched to the second set. At 4:00 it was decided that to attempt control as two separate fires was unsafe.

At 5:00 p.m. the air scout reported that the fire looked as if it was going to cross the creek at the southeast corner. At 5:15 White and crew were dispatched from the Six-mile fire to prevent this crossing. Farther west and north spotting was frequent. Wind was now estimated at 25 miles per hour with direction changeable. Backfiring was extremely difficult and had to be done with caution because of the large amount of fuel and the shifting winds.

Shortly after White and crew started building line from the northeast corner, Earl Veal and crew reached the fire and started helping with the line in a southwest direction. As a safety measure White sent crew leader Veal ahead to the junction of the hollows to scout the possibility of the fire crossing over below them. White had previously scouted ahead and found a dropoff with slopes about 75 percent. Before Veal had time to reach the junction, Ranger Nix, who was fire boss and located in Wauchesi lookout tower where he had full view of the fire, noted a small flare up ahead of the fireline. Nix informed and cautioned White and Veal. Shortly, Veal called for help to prevent the fire from crossing the hollow. White sent 5 men with instructions to hurriedly make a preliminary line down the dry branch bed which was more free of debris. In 2 or 3 minutes the spot looked as if about half an

acre exploded. Nix again informed and cautioned White and Veal. White started down the hollow to investigate, and met Veal coming up the hollow.

In the meantime, Nix ordered all air communications traffic on the three southend districts clear for Veal and White and safety of the men.

An alternate escape route into a burned area was designated for Veal and the five men. White gave Veal instructions to let him know when the fire crossed the hollow. White ran back up the line to the other men to recheck and review safety route. Within a few minutes, Veal notified White that the fire had crossed the hollow. White divided the men into two groups. As an escape plan, the first group was to go within a burned area above them and the men on the south end to go within a burned area to the south and west of the junction of the hollows.

The wind shifted to east northeast. White spaced the 16 men on this sector about 50 feet apart and backfired the preliminary line. The men were kept as two groups to carry out the safety plan if need should arise. The men held the line which was approximately 6 chains.

Control of the fire without injury or worse was due to—

1. Basic training, and particularly reviews on tragic fires in the West in recent forestwide and district training sessions, in both forest fire safety and suppression.
2. Two-way radios.
3. Ordering the air cleared for safety.
4. Ranger Nix's view of the fire from Wauchesi lookout.
5. Ranger Nix's knowledge as to location of crews.
6. White's experience in fire suppression.
7. White's control of his men. All remained relatively calm.
8. The preliminary fireline.
9. Shifting wind to east northeast.

[Knowledge and application of the Ten Standard Fire Fighting Orders.—Editor.]

HOSE FOLDING JIG

L. F. DEYAK
Fire Control Aid, Ely Service Center, Superior National Forest

For efficient laying of folded hose, whether from packsack or pack frame, neat, compact, evenly folded hose is necessary. Past methods of folding produced irregular, loosely packed, costly hose folds which quite often when being strung out became fouled, causing undue delay.

To eliminate these problems a simple hose folding jig has been constructed on which the hose is folded compactly and efficiently. Hose folding time has been cut at least in half.

Base of jig is a frame 42 inches long by 24 inches wide constructed from 1- by 6-inch lumber. Into base are placed $\frac{1}{2}$- by 3-inch hardwood dowels. A piece of $\frac{3}{8}$-inch plywood 36 by 24 inches with matching $\frac{5}{8}$-inch holes to fit over base and dowels completes the jig (fig. 1).

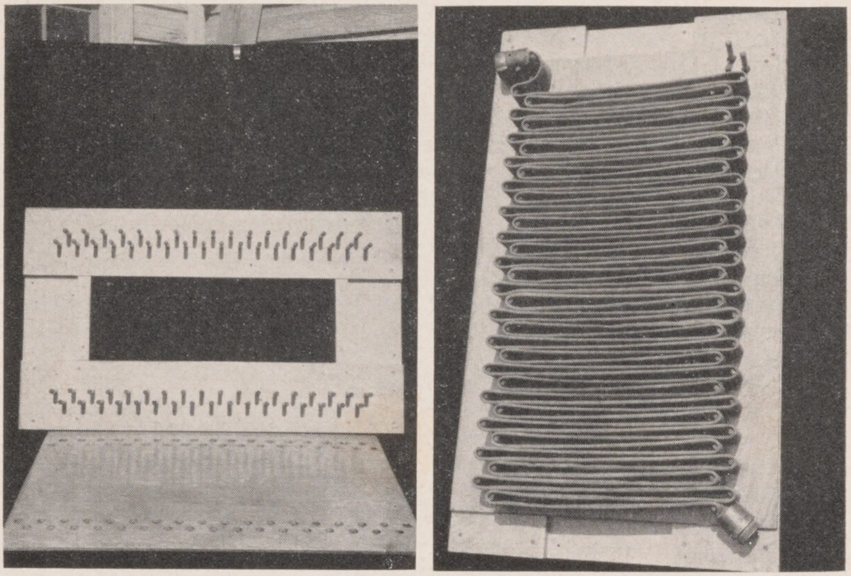

FIGURE 1.—*Left,* Base with dowels and plywood holder; *right,* folded hose ready for plywood holder to be lifted.

Starting with either male or female end, hose is then folded over and between dowels. Upon completion of fold, plywood board is lifted from base and dowels. Hose can then be slid from board into packsack, tied for storage in fire cache, or held by rubber bands for use on pack frame.

TELEPHONE RECORDER AS A DISPATCHER'S TOOL

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Electronic Technician, Kootenai National Forest

A means of recording telephone traffic at the forest dispatcher's desk during project fires to facilitate the logging of traffic and to provide a verbatim record was desired, and the following requirements were established:

1. The recorder must not interfere with normal phone usage.
2. Legal requirements, and telephone company rules, must be met.
3. Both incoming and outgoing conversations must be recorded.
4. The recorder must be simple to operate.
5. A means of indexing the recordings must be available.
6. Recording levels must be maintained as nearly constant as possible with varying line losses.

Various tape, wire, and disk recorders were investigated, but most of these were found to be unsuitable for at least one of these reasons:

1. Poor indexing—desired material could not be quickly found and replayed.
2. Dynamic range too large—if recording volume were turned up for weak voices, strong voices would blast the listener severely, especially with headphones.
3. Costs of extra equipment were considerable.

The Edison Voicewriter with 7-inch disks, used for dictation, was then tried, and it worked very well.

1. Indexing is very good—a calibrated card goes with each disk, on which can be marked pertinent data, such as dates and times, with punchmarks showing stops and starts.
2. The dynamic range is limited making the recorded levels quite constant.
3. The unit is simple to operate.
4. Recording time is limited to 15 minutes for each disk side, but it takes only seconds to change disks.

An adaptor to connect the recorder to the telephone was built (fig. 1). A special plug to fit the recorder must be put together or obtained from a dealer. A transformer is used to isolate the unit from the telephone circuits, and this should have approximately a 600-ohm primary and a 200-ohm secondary. This will bring the telephone line level to about the same as the microphone level, so the recorder may be used on either service without readjustment. A double-pole double-throw toggle switch is used to start and stop the recorder and to disconnect the unit from the telephone. The recorder runs when its switch is in the *open* position, opposite the normal type of switching.

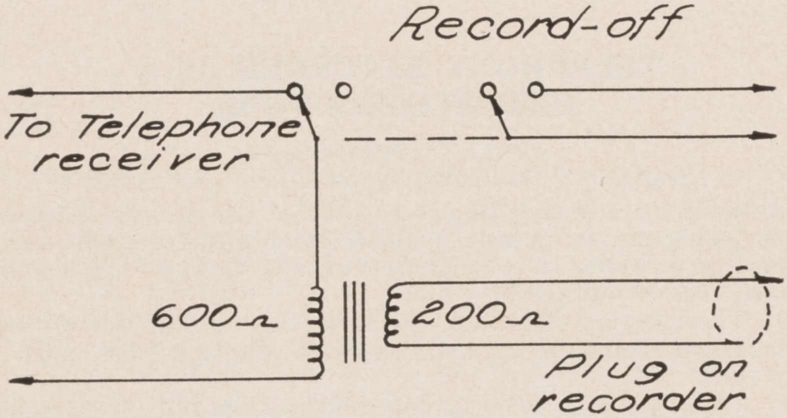

FIGURE 1.—Wiring diagram for telephone recorder adaptor.

To satisfy the legal requirement of telephone recording, the telephone company attached a recorder connecting unit to the telephone. This unit makes the high-pitched "beep" tones that signify recording.

In order to get a more constant level, the local voice should be made weaker when recording, so the distant voice can be amplified. The recorder connecting unit as supplied has no such provision—the output from it to the recorder merely comes from the line. Therefore, with the cooperation of the telephone company, a separate pair of leads was run into the telephone, connecting to the receiver terminals instead of to the line. Because of the antisidetone features of modern common-battery telephones, the local voice doesn't reach the receiver with much volume, and this makes a much better recorder connection. The adaptor as built uses plug-in connections so the unit can be put away when not in use.

An incidental feature of this unit is that the records may be played back over the telephone merely by setting the controls for playback and turning on the switch with the recorder still connected to the phone. The volume can be adjusted to suit with the front control on the recorder as in ordinary playback with headphones.

The telephone recorder in use helps the dispatcher by relieving him or his clerk of the job of recording all details of each fire message during the conversation. Orders for manpower and equipment may be verified by playing back the disks, and any instructions given or agreements made are put on record. The net result is that chances of error in recording detailed messages are reduced, with the dispatcher free to take brief notes, depending on later playback for details such as subsistence or other requisitions.

BATTERIES FOR HEADLIGHTS

Charles P. Egger
Electronics Engineer, Forest Service Radio Laboratory

The dry battery, supplying the need for packaged electricity to headlights is one of the common and most necessary articles used by firefighters. Important technological developments stimulated by World War II and the "Space Age" have brought about a sudden demand for new batteries. This has led to improved types for existing applications, as well as new batteries to meet new service requirements. This report gives information on the relative efficiency of new design types of batteries for headlights.

Manufacturers have shown considerable interest in making batteries that meet the general requirements of the Forest Service. They have furnished us with engineering samples and invited our comments and recommendations. This cooperativeness from industry has been utilized by making laboratory evaluation tests and providing field tests to determine whether the batteries meet our needs.

Standards in industry for batteries of the same type are not too consistent. For example, batteries classified as "industrial" types by different manufacturers differ widely in life characteristics, total capacity, storage life, and price. One manufacturer makes five different kinds of flashlight size "D" cells, under classifications of regular, industrial, heavy-industrial, radio, activator, energizer, or other distinguishing nomenclature. These batteries are intended for a particular type of service, though the claims of the manufacturer are sometimes not clear.

The "D" size flashlight cell has long been generally used in headlight service. It is a cylindrical (nominal dimensions 1¼ inches in diameter, 2¼ inches in height), zinc-manganese dioxide mix dry cell commonly called LeClanche after its inventor. However, the voltage produced by these cells under high, continuous drain service drops at a high rate, resulting in poor performance of headlights and frequent changing of batteries. Leakage, swelling, and corrosion due to perforation of the zinc can is a problem. Large quantities of dry cells of all types are thrown away each year because of deterioration in storage.

This investigation has included the following:

1. Comparative information about service and shelf life on the different types of "D" cells.
2. A study and evaluation of the magnesium-cuprous chloride (water-activated) battery.
3. A study and evaluation of an alkaline mix battery in the "D" and "½D" size.

The test that best represents any particular service is that which most nearly duplicates the rate-of-energy output of the battery when in actual use. Most of the batteries were given continuous and intermittent duty tests, made when the batteries were

fresh and after they had been stored for given lengths of time. Continuous discharge reveals the general discharge characteristics more quickly, but these characteristics are not conclusively related to results obtained in intermittent tests. The tests that we used approximately duplicate conditions of our particular use where the goal is to furnish the best possible light output from headlights for a minimum of 8 hours continuously (in night-shift firefighting for example). The intermittent duty test cycle of 8 hours discharge with 16 hours recuperation time was chosen to determine if more than one night's service could be obtained with the more expensive types of "D" cells.

Visual inspections for corrosion were made when the cells were removed from storage. Samples of alkaline and water-activated batteries designed especially for headlight service were purchased and distributed to the regions for field tests with sample headlights (fig. 1).

FIGURE 1.—Batteries: "½D," "D," alkaline plug-in, and water-activated; economy headlight.

From the test results in the laboratory and the manufacturers' published data, "D" cells are classified according to service life in hours as follows:

Class I —Regular general purpose LeClanche cell.
Price range—.05–.06 (GSA stock item).
10–12 hours continuous service to 1 volt per cell.
12–15 hours intermittent service to 1 volt per cell.

Class II —Industrial or premium type cell.
Price range—.08–.16.
13–20 hours continuous service.
14–25 hours intermittent service.

Class III—Industrial or premium type cell.
Prince range—.10–.15.
21–29 hours continuous service.
26–34 hours intermittent service.

Class IV—Alkaline cell.
Price range—above .30.
More than 30 hours continuous service.
More than 35 hours intermittent service.

Comparative discharge curves, continuous and intermittent of cells of all classes, are shown in figures 2 and 3. For Forest Service use voltage below 4 volts is not considered adequate.

Class II cells do not give significantly longer life, on a cost per hour basis, in continuous duty tests than the cells of Class I (fig. 2). They do have somewhat longer life when tested in intermittent service (8 hours on, 16 off) but it is not commensurate with their increased cost. The terminal voltage falls near or below the specified end-point before the end of the second discharge period (fig. 3). However, the cells show potential use (after recuperation) though at voltage near the end-point.

Class III cells are clearly superior to either Class I or II cells, both in longer hours of service and a higher average terminal voltage, and on a cost per hour basis should be considered for use. Corrosive tendencies are a potential disadvantage. Five cells out of forty-eight samples of one manufacturer's product were corroded when removed from storage. After discharge, corrosion at the positive terminal was rapid on most samples. The manu-

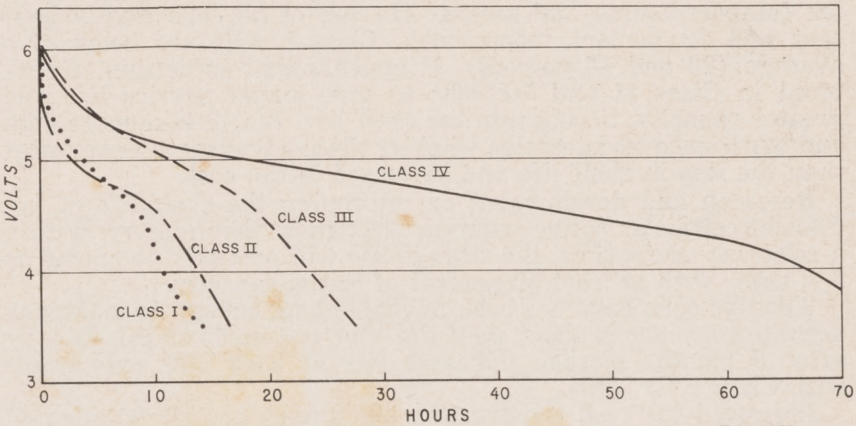

FIGURE 2.—Typical continuous discharge curves of classes of "D" cells.

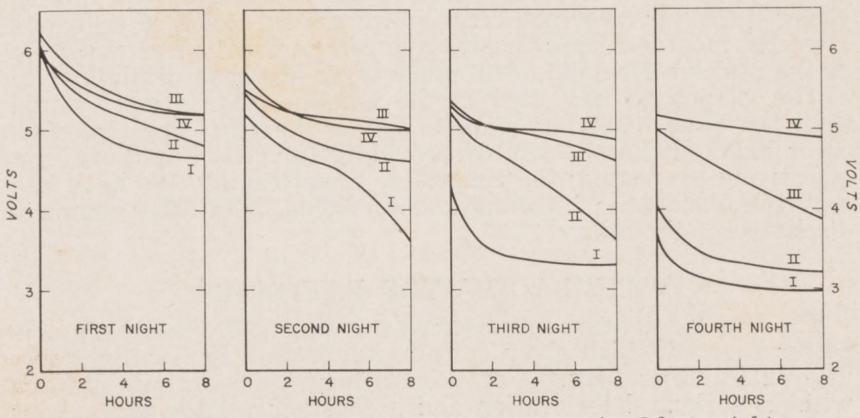

FIGURE 3.—Service life of "D" cells over successive 8-hour nights.

facturer says this is due to the use of a "hot" mix for longer life and greater capacity. This tendency toward rapid leaking and corrosion of this class cell has also been noted on another manufacturer's product which has recently been sent to the laboratory.

The Class IV alkaline cell is in a class by itself. Commercial manufacture is recent, although cells of this type were first described in literature in 1912 and were studied sporadically up to 1936. In the original form it was of a wet type, nonportable, large, and restricted to an upright position. Improved manufacturing techniques have enabled production on a commercially practical basis. It has been described as a combination of good features of the LeClanche and Mercury types of batteries. The discharge characteristic shows that its curve is flatter and many times longer than the LeClanche (Classes I, II, and III) (fig. 2). While it costs about five times as much as a regular "D" cell, it does provide proportionately longer service as related to cost, especially at heavier drains.

After 18 months of storage at room temperature, Class I cells showed a service life loss of about 20 percent. The average capacity (ampere-hours) and service life loss of all cells was 25 percent and 22 percent respectively. Class I cells are below this average (23 and 18 percent). It appears that as designs are altered in Class II and III cells to give longer service life and greater capacity, it cuts into the shelf life. It will take more data and experience to determine whether these advantages are greater than the loss in shelf life and increased initial cost.

Research and development on improving the shelf life of LeClanche cells is an active program throughout the industry. Within a relatively short time, the storage life will probably be quoted as 3–5 years with at least 50 percent of initial capacity.

Alkaline cells have not been available long enough to make any definite conclusions about shelf life. One test made on this battery after 8 months storage indicates loss of shelf life comparable with Class I "D" cells.

Improved "D" cell construction has almost entirely eliminated leaking and corrosion. After 18 months of storage at room temperature, none of the cells showed any corrosion or swelling, either before or after discharge. With the exception of the Class III cells, mentioned previously, zinc can perforation or corrosion at the positive terminal of all other types has been negligible.

The electrolyte mix used in the alkaline cells is more liquid than the zinc manganese-dioxide LeClanche mix. The manufacturer has had the problem of providing for cell "breathing" yet effectively preventing the electrolyte from leaking. We have had only two incidents of leaking and corrosion, both after complete discharge of the cells.

WATER-ACTIVATED BATTERIES

The water-activated cell systems are among the relatively new power sources which show definite advantages in headlight use. The outstanding features of this battery are indefinite storage without serious deterioration and a constant voltage throughout

its useful life. The batteries are stored dry in an inactive condition in hermetically sealed containers and are activated merely by adding water.

The sustained higher terminal voltage of the water-activated battery is shown in figure 4. This would produce a more brilliant light over the period of its use. It takes about 2 hours to reach full voltage of 5.5 volts, but usable output occurs in 5 to 10 minutes. As long as moisture is present in the battery it will continue to dissipate itself until the chemical reaction is complete, whether under load or not. Adding more water will not extend its life. Leaving the battery submerged in water reduces its service life.

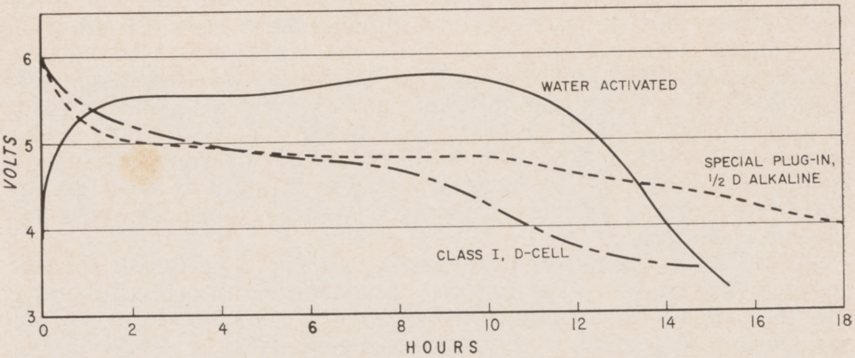

FIGURE 4.—Comparison of continuous service life of alkaline and water-activated headlight batteries.

Although this battery is supposed to have no deterioration in storage, laboratory tests disclosed some loss in service life of batteries that were stored on the shelf and sealed in plastic bags only. The average capacity loss of four batteries stored for 8 months at room temperature was 21 percent.

We believe that the plastic material used for a container does "breathe." Any moisture from the air would cause partial activation during storage. This could be a serious problem in humid climates. Therefore, water-activated batteries should be stored unopened in the original shipping cans until distributed for use. If only part of the contents of a can is used at one time, the can should be resealed to prevent any deterioration. Batteries stored for 8 months in sealed shipping cans showed no loss of service life.

During and after discharge, a green, corrosive-looking residue is produced. This residue is not harmful to skin, clothing, or metals. Several inquiries have been received about the odor of the batteries during storage and during use. It is not explosive or toxic. The opening of large quantities of these batteries in a confined space should be avoided as the accumulated odor can be obnoxious. The battery has the characteristic of evolving heat during discharge. This makes them applicable for operation at very low temperatures.

ALKALINE PLUG-IN BATTERY

Another type of battery made by a manufacturer for headlight service uses the alkaline-mix electrolyte (Class IV) cells of size "½D." A series-connected package of four of these cells with a socket (ASA IV) make up a self-contained 6-volt headlight battery with increased service life and total power output over standard "D" cells (figure 4). Generally, the data presented about the Class IV cells apply to this one except that its total capacity is less because of smaller size. Its service life is about 18 hours compared to 11 hours for a Class I "D" cell.

The alkaline and the water-activated batteries will furnish a longer and brighter power source in headlight service. The alkaline battery and the economy headlight make a good combination for general intermittent uses, while the water-activated battery makes an excellent power source for one period of continuous use. Both batteries can be used interchangeably with the economy headlight since no battery container is needed and a standard 6-volt socket and plug is used. Forest Service specifications have been issued for each type of battery and the headlight.[1] Cost of the batteries, while relatively high now, will be lower as purchase volume increases.

A test and evaluation program on all types of batteries that might be adapted for headlight use is continuing at Beltsville under the Technical Equipment Development Program. Engineering samples of a new type of LeClanche cell, using a "cathodic-envelope" type of construction, has been sent to us. This one shows promise of about three times the life of a "D" cell with a higher average discharge current.

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[1]Specification 150—Economy Headlight.
Specification 160—Alkaline-Type Dry Battery (6 volts).
Specification 161—Water-Activated Battery (6 volts).

PORTABLE TOWER

Stuart B. McCoy
Ranger, Tomahawk Forest Protection Headquarters, Wisconsin Conservation Department

A portable tower that can be erected to a height of 102 feet in less than a day, and requires no nuts, bolts, or other loose parts in its erection, is now in use by the Forest Protection Division out of the Tomahawk Headquarters (fig. 1).

This tower is composed of 17 aluminum-alloy, upright, one-piece folding sections which are easily transported from place to place on one long-wheelbase truck. Each section is 4 feet wide,

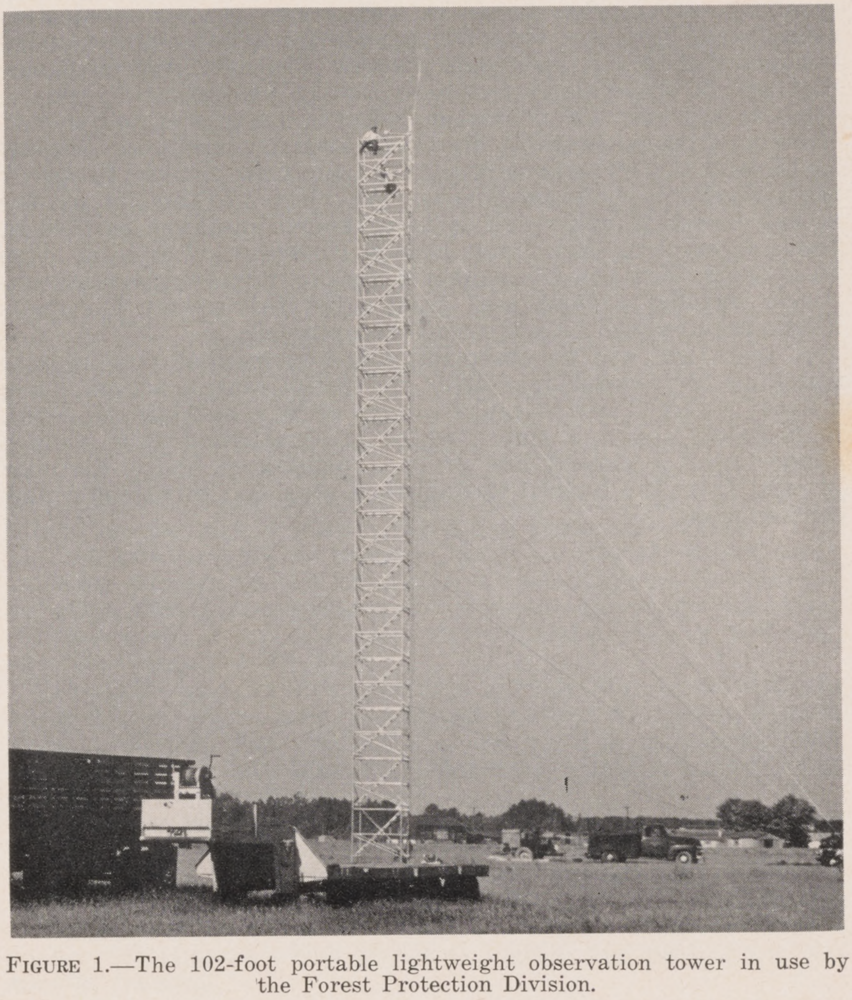


Figure 1.—The 102-foot portable lightweight observation tower in use by the Forest Protection Division.

6 feet deep, 6 feet high, and has a 7-rung stepladder in its interior. Special locking hooks join the folding parts together. Each separate 6-foot section is likewise securely fastened by a stainless steel pin to lock a specially designed hook in place.

The tower can be erected in any location and requires only a plank foundation. It is guyed with cables to prevent swaying in the wind. Interior stairways have a self-cleaning scraper-type tread on each step which removes snow, mud, or grease from the climber's shoes.

This tower will have three important uses. It is now being used in many different locations throughout the State in making a survey of radio signal strength. The present forest protection radio frequency is subject to considerable interference from foreign radios particularly in Central and South America. Spanish-speaking voices often break in and drown out communication even on bad fire days. New frequencies are to be assigned, and it is hoped that by the use of this portable tower the ideal frequency that will be free from interference can be determined.

There are over 130 permanent observation towers now in use. Growing trees, changes in district boundaries, and poor original locations make relocations necessary from time to time. Presently the highest hill in the neighborhood is selected as the site, but the actual view that will result is never known until the permanent tower is erected. Oftentimes nearby ridges or other hills cause blind spots. This can be avoided if the preliminary tower investigation includes a "look see" from a portable tower. The exact height required can be determined beforehand.

A third use will be observing large burns that may require watching for several days after the initial control action. From a tower set up in the center of a large burn, a watcher can detect immediately any new smoke which gives warning of a possible danger near a plowed line or of a windblown spark that has jumped from the burned to unburned area and threatens a new conflagration.

PLATE GLASS FOR OLD FIRE TOWERS

Carl Burgtorf
District Ranger, Cumberland National Forest

This experiment included the removal of the nine-pane, metal-sash window frames from a 7- by 7-foot cab steel fire tower, and the substitution of plate glass of the quality used in department store windows. Salvage glass from large display windows was used in our final installation.

Considerations in making the change.—(1) The excessive glare and heat from the vertical glass could be reduced. (2) Since it was obvious that more sky was exposed than necessary for adequate coverage of the land surface watched by the towerman, glass area could be reduced. (3) The old sectional frames were hard to adjust for ventilation. (4) Caulking around frame joints and glazing was difficult. (5) Rain streaks and dust accumulated on the vertical glass, and the small sectional windows required frequent cleaning. (6) The sash caused obstruction to vision and shadow effect not present on large windows tilted out at the top.

Installation of new frames and glass.—After removal of the old window frames only the angle-iron tower corners remained to support the cab roof and to provide support for the new framing material. The opening created extended from a point 43 inches above the floor to the cab ceiling, a vertical space of 42 inches.

The top line of vision for a tall man was marked by actually sighting across the cab interior and including enough sky so that only a narrow area above the horizon would be visible. The lower edge of the required line of vision was marked on the frame, and we found that we needed only 20 inches of vertical glass area. Towers in steep mountainous area may require more glass height.

Three and one-half inch galvanized angle iron, salvaged from an old tower frame, was used for the top and bottom horizontal frame for the new window. These two pieces are wedged, with lead wedges made in the required shape, so that the two flat surfaces are parallel to each other and perpendicular to the edges of the glass. This allows a tilting of the upper edge of the plate glass outward about 2 inches beyond the vertical to reduce sun glare and reflections (fig. 1).

The angle iron corners present a narrow edge of steel to the window area which must be widened to about 3½ inches to complete the frame. The welding of a flat piece of galvanized iron, 3½ inches by ¼ inch thick and the needed length is a simple way to complete the side of the frame.

The plate glass is mounted in a "U" shaped channel which becomes a permanent track and protection for the bottom edge of the glass. This metal edge rests on ball bearings (fig. 2) of the "show-case" type of double channel which is permanently screwed to the angle iron surface. The top of the glass slides in another double "U" channel which serves as a guide and part of the permanent framing.

FIGURE 1.—Three and one-half inch galvanized angle iron, salvaged from an old tower frame, was used for the top and bottom horizontal frame for the new window.

Plastic caulking compound was used to seal all cracks between welds and metal joints. A rubber weatherstrip was cemented to the flat metal surface so that the end of the plate glass closed against its edge thereby making a weatherproof seal.

The two glass windows slide past each other to provide ventilation and for ease in cleaning the outside surfaces. The space between the two glass surfaces may be sealed against wind and rain by cementing a narrow rubber strip to one glass surface allowing space for movement.

The plate glass used is 8/32 inch thick with two ground surfaces and must not be confused with ordinary 7/32 inch plate which usually has too much distortion for tower use. We secured glass with a slight tint of green color.

The remaining space between the new frame and roof is sealed with aluminum "valley" metal, held in place with rustproof metal screws. Cracks are sealed with plastic caulking compound and all metal painted with aluminum paint.

Summary of experimental installation and results.—Removal of the old window frames, cutting and fitting of angle-iron frame material and filling in with aluminum sheet-metal was accomplished by the towerman and regular district personnel. The glaziers performed their work on a contract basis; this included the double-track channels, top and bottom, cutting the plate glass and grinding the edges for safe use, cementing a "U" track to the

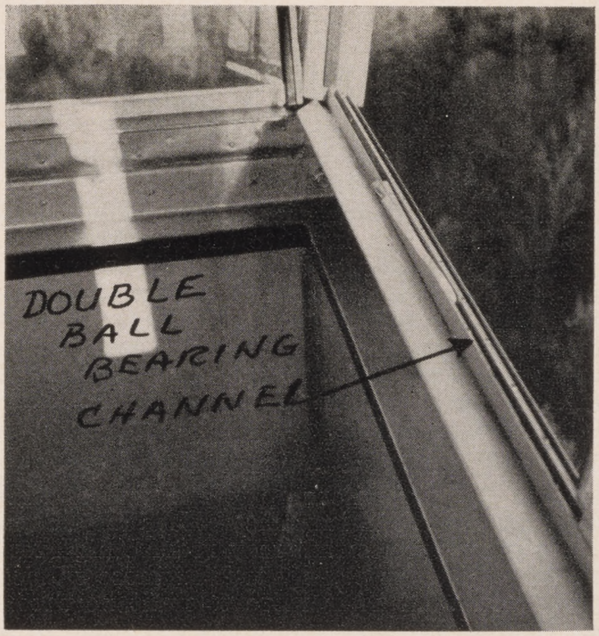


FIGURE 2.—The plate glass is mounted in a "U" shaped channel which becomes a permanent track and protection for the bottom edge of the glass.

lower edge of each glass to act as a protective running strip, and final fitting of the glass. The cost of glass installation, including the glass, channel materials, and the services amounted to $45 per side, or $180 for the 7- by 7-foot cab.

Satisfactory results from the new plate glass windows include greater visibility, especially during evenings and mornings when the sun is low; greater ease of cleaning with less streaking from dust and rain; much less heat from the sun's rays and a tower that is easy to ventilate and much more comfortable for the towerman.

USE OF FIRE IN FOREST MANAGEMENT[1]

ROBERT D. MCCULLEY
Chief, Division of Forest Management Research, Lake States Forest Experiment Station[2]

Fire is used in timber management mainly to help establish new stands. Prescribed fire can improve the seedbed, clean up green and dead fuels from a planting site, or control undergrowth during the life of a stand so that competition with seedlings can be held to a minimum when reproduction cuts finally are made. Its use for these purposes has been limited to certain geographic locations and to timber types where conditions of weather, fuel, and topography offered special reason to expect success. This has been mainly in the South and West.

Natural fires influence forest composition

That fire has had a relationship to the kind of timber in the forest is long established. This seems obvious for jack pine, lodgepole pine, and other species that may require high temperatures to release their seed. It is equally true of those species that lose out in competition with their more tolerant neighbors if some disturbance such as fire does not upset the trend of succession. Douglas-fir is such a tree. So are white pine, loblolly pine, quaking aspen, and many others. The list is long, and it tends to grow longer as we glean more ecological information from the forest.

Fires favor certain tree species in several ways, thus perpetuating cover types that tend to lose out in competition with those higher on the successional scale. They kill back the competitors and, if intense enough, reduce their numbers. They remove litter accumulations and expose mineral soil, the favored seedbed for many forest trees. Also, in general, they provide the conditions of light, temperature, and moisture relations that, temporarily at least, favor the establishment and growth of the so-called fire types. Fire species tend to be light seeded and aggressive in filling in denuded areas. They are intolerant of shade.

Prescribed and uncontrolled fires may not produce same effects

A forester's first acquaintance with fire was generally in trying to control it. As a byproduct of its destructiveness he saw some of the things it accomplished in selected areas—the freshening of forage for domestic livestock in the South, the fortuitous thinning of dense young stands of ponderosa pine, the sanitation removal of brown-spot needle blight of longleaf pine, the release of seed held in serotinous cones of jack pine, the improved seedbed and generous establishment of numerous species in all sections of the country.

[1]Condensed from a paper given at the Region 9 Fire Meeting, June 12, 1958.

[2]Maintained at St. Paul 1, Minn., by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of Minnesota.

However, the link between the action of wildfire and the prescription and use of fire for specific purposes is not necessarily very strong. The users must assure control within prescribed boundaries. And damage to residual trees must be held within tolerable limits. These limitations tend to reduce the intensity of prescribed fires and thus to curtail their effectiveness for some purposes. Fire intensity especially is a problem where selective action is desired where unwanted vegetation must be killed and valuable vegetation saved.

Properly prescribed fire does not seriously threaten soil productivity

Many foresters are apprehensive about the long-term effects of fire use on the soil. Generalizations on this point pervade the literature. Yet there are few things less subject to generalization. The possible variation in any fire situation is tremendous. It is not enough to assume that because organic litter is a valuable soil conditioner, and because fire destroys litter, that fire necessarily is destructive of soil values. There is much more to the story than that.

In some situations fire certainly lowers soil productivity. I can outline a case where there can be little argument. South of Plymouth, N. C., is a stretch of country that can only be described as desolate. To a forester it may resemble early photographs of the stumpland wastes left after removal of virgin white pine and the subsequent fires in the Lake States. As far as the eye can see stretches a swamp populated by cotton bullrushes and other aquatic vegetation. Stumps and snags poke up through it. This is the result of fire following logging on organic soil. The soil itself has been burned away, making natural establishment of trees impossible.

Another case is where fire removes the protective mantle of organic matter from the soil and destructive erosion results. The extreme example is the Southern California mountains where flood has followed fire on many an occasion. Less spectacular, but no less serious destruction of the soil has occurred in many other places.

If we rule out places where peat will burn and where erosion is a serious complicating factor, we come to an area where there still is much room for difference of opinion. However, the evidence from research on the effects of fire on the soil can narrow that area of possible disagreement.

First of all fire temperature seems to have very limited influence on the mineral soil itself. Soil samples from burned and unburned areas were analyzed following the severe fires of 1918 which destroyed Cloquet, Minn. They showed no loss of nitrogen from the surface layers of the mineral soil. Except where heavy fuels burn for long periods of time, as may occur in slash disposal, the temperature effect downward into the soil is limited to a very thin layer.

Soils from which the organic mantle has been burned away, time and again have shown higher levels of some nutrients other than nitrogen than similar unburned soils. Even though nitrogen is

driven off from the litter as one of the products of combustion, the loss is of questionable importance at least in some cases. Prescribed fires seldom burn away all of the undecomposed organic material, and may remove a negligible amount. Many cases of a nutrient situation after burning have been shown by chemical analysis, by comparative growth of annual plants, and by comparative growth of pine seedlings on burned and unburned areas. There is no long-term history of soil nutrient relationships under controlled conditions. However, even though the story is incomplete it gives us some assurance that periodic use of fire poses no serious threat to soil productivity from the nutrient standpoint.

On the other hand the physical condition of the soil is impaired by repeated clean burns. Where this occurs it will accentuate runoff problems. A single, severe slash disposal fire in Douglas-fir, under current slash-burning practices, has only a minor influence on physical characteristics of the soil.

The main use of prescribed fire in this country has been for protection. However, in a few instances it has become a standard tool in timber management. Notable is its use for hardwood brush control in the South and Southeast.

Some of the variability in fire effects can be reduced by modifying the fuels. In the California foothills brush has been made more flammable through being mashed down with a bulldozer and allowed to cure before burning. Areas treated in this manner can be burned when the general fire hazard is relatively low. Area ignition, the simultaneous firing of numerous places in the burning unit, has achieved somewhat the same results through providing a quick buildup in temperature with resulting intense and clean burns. These methods of increasing the intensity and uniformity of fires have been used in range improvement work. They have possible application in replanting site preparation.

Effects of seedbed improvement with fire have been worked out for several of the soil conditions within the loblolly pine type. In general, the improvement is substantial but not as great as with mechanical scarification. However, fire has been less expensive to apply. Results are good where bird and rodent populations are low and where climatic extremes do not lead to heavy losses of germinated seedlings. Burning favors successful establishment of longleaf pine. Variable results from field trials have been reported for many other species including jack pine.

To sum up the present status of fire use, we can point to relatively few places where it is included in the routine of timber management. Hardwood control in the South is the major one. There are many examples of application on a small scale. There are even more test runs of an investigative character. Solution of problem situations through fuel modification or by other means can be expected to broaden general application where some of the limited trials now are being made.

"COOL" BURNS AND PINE MORTALITY

E. R. Ferguson, C. B. Gibbs, and R. C. Thatcher
Nacogdoches Research Center
Southern Forest Experiment Station[1]

Fire damage does not always have to be spectacular to kill trees. In east Texas, on a 10-acre experimental area where prescribed burns have been used periodically to reduce the hardwood brush

[1]Maintained in cooperation with Stephen F. Austin State College, Nacogdoches, Tex.

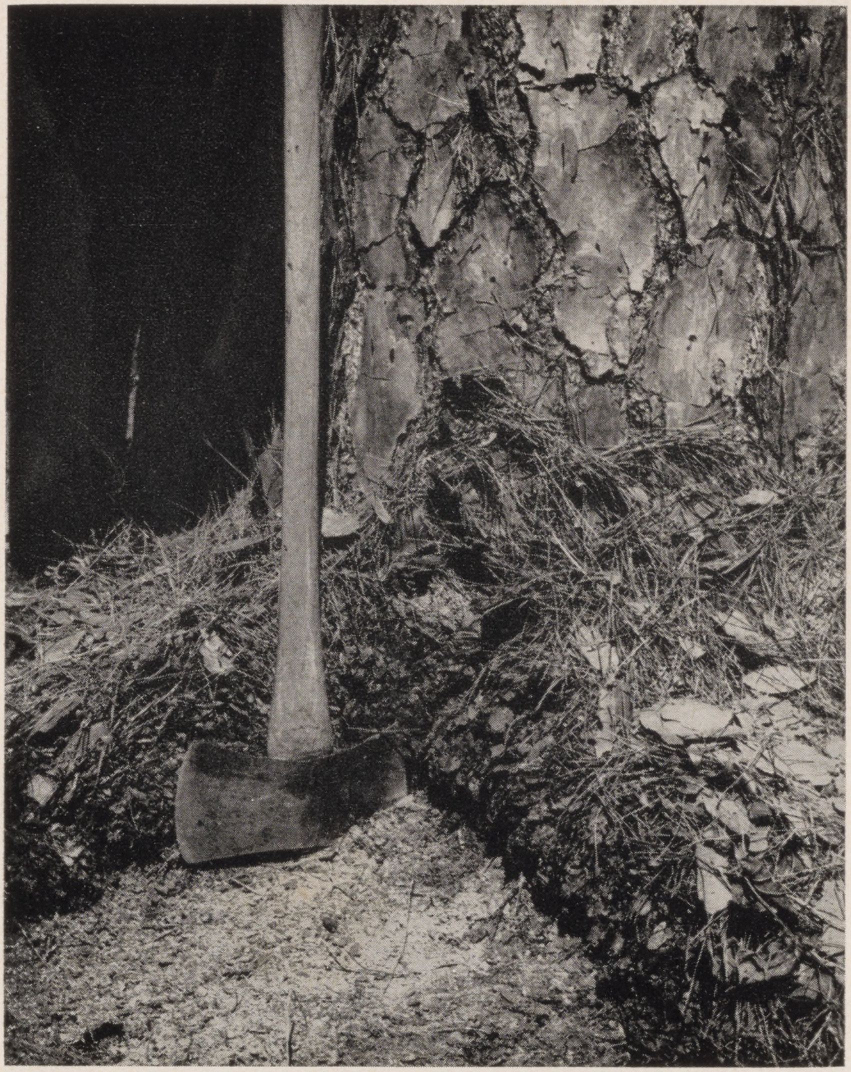


Figure 1.—Sloughed bark, dead needles, and other debris were piled up around the bases of large trees.

and to improve seedbed conditions, a low, creeping "cool" fire in October contributed to the death of 110 loblolly and shortleaf pine trees, approximately 10 percent of the merchantable stand.

Fuels were variable, ranging from very thin mantles of recently fallen leaves and needles to domelike accumulations of bark and needles at the bases of some of the pines (fig. 1).

Fuel moisture was estimated at 6 percent by basswood fuel moisture sticks. Wind velocity was variable, but averaged 5 miles per hour at a standard weather station. Through much of the area, the lines of fire were difficult to sustain and flames were low and slow moving. Continual refiring was necessary to maintain an unbroken line, and coverage was quite spotty.

When the burned areas were inspected shortly after the fire, no trees were classed as damaged under the recently described criteria of crown scorch and trunk scorch,[2] which emphasize height and extent of char.

Approximately 6 months after the burn, the area was revisited, and there was still no apparent evidence of weakened trees in the stand.

[2]Ferguson, Edwin R. fire-scorched trees—will they live or die? La. State Univ., School of Forestry, Fourth Ann. Forestry Symposium Proc., pp. 102-111, illus. 1955.

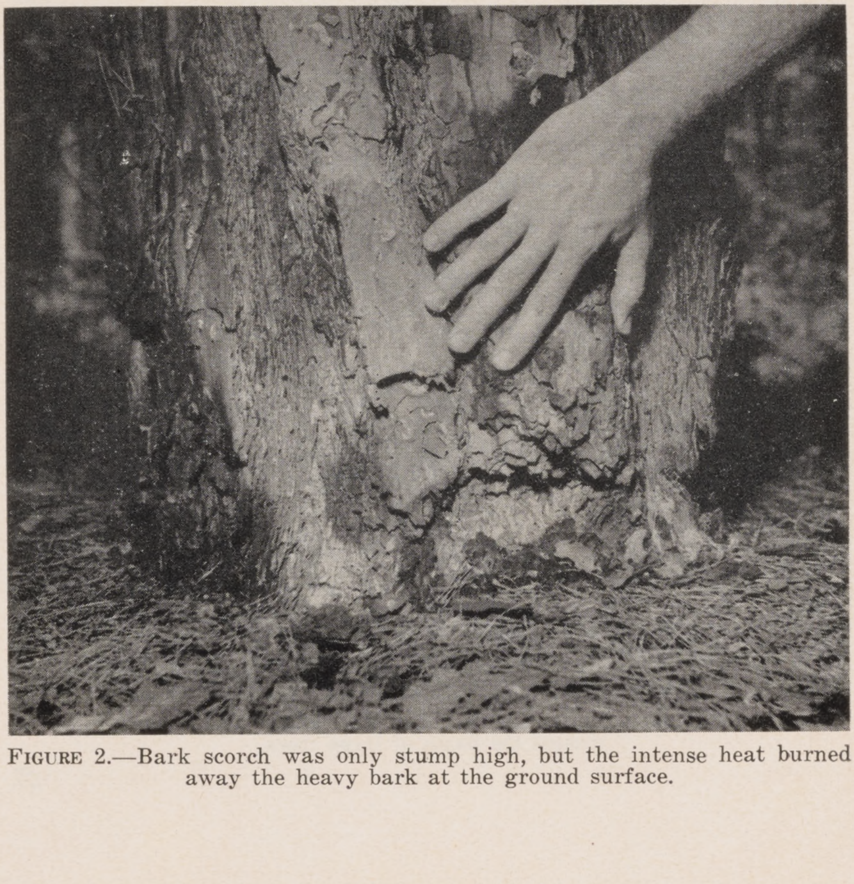


Figure 2.—Bark scorch was only stump high, but the intense heat burned away the heavy bark at the ground surface.

Then, 18 months after the fire, another routine check found many of the pines dead or dying. Turpentine beetles (*Dendroctonus terebrans* Oliv.) were active, and a number of trees with green crowns were under heavy attack by ambrosia beetles (*Platypus* sp.) alone.

Careful examination revealed that the primary cause of mortality was the fire. Although the scorch signs were rarely more than 8 to 16 inches high on the trunk, the fire had burned deep depressions in the bark—an indication of prolonged high temperature at the groundline (fig. 2).

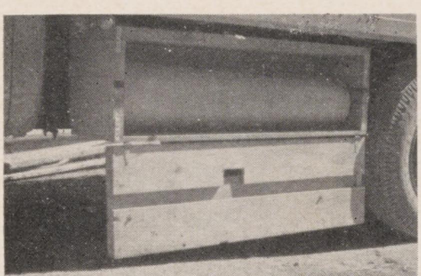
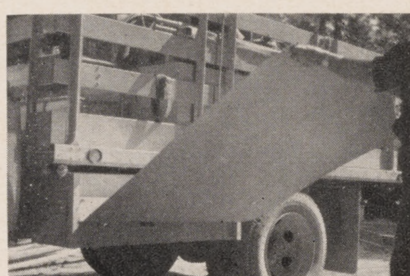
Attacks by the black turpentine beetle contributed to the mortality. However, the activity of the ambrosia beetle, which normally attacks only dead or dying pine trees, indicates that many of the damaged trees would have died had there been no turpentine beetles.

This experience suggests that assessments of fire damage, for salvage or other purposes, should not be limited to scorched crowns and trunks, but should also include low basal scorch, particularly following slow, low-burning ground fires in areas with heavy litter accumulations.

☆ ☆ ☆

Box for Paper Used to Cover Slash Piles

Rolls of Kraft #30 paper used for covering piled logging slash are heavy and awkward to handle when being loaded, unloaded, or unrolled for cutting sheets to desired size. Transportation of the paper rolls requires either a separate vehicle or the roll must be securely tied down before crews can be safely transported in the same truck. It is difficult to unroll the paper and cut sheets without laying the roll down. Holes and tears in the paper are caused by objects on the ground or truck bed as the paper is unrolled. If the roll is new the weight of it requires two people to unroll it. Should the ends have been dented or bashed in while being handled or transported, unrolling without tearing is sometimes impossible.

We devised a carrying box that is bolted to the underside of a truck bed directly behind the cab and in front of the rear wheels. It holds the rolled paper on a pipe spindle. The box was designed for a 2-ton, 350-gallon tanker truck, but can be made any length the truck will accommodate.

This box will hold a roll 48 inches long and 12 inches in diameter. The paper is pulled through a slot and cut to length needed by pulling the paper up against the cutting bar which also serves as a covering over the slot. The

cutting bar is 1- by 6-inch clear Douglas-fir held in place with spring loaded bolts. A metal cutting edge can be attached to the bar but is not necessary with kraft paper. The ends of the box are plated with ⅛-inch steel and serve as rock shields, reinforcement, and hangers for bolting to truck bed joists.—ROBERT GILMORE and CLINTON BLAINE, *Rogue River National Forest.*

☆ ☆ ☆

Metal Clips Replace Plastic Loops on Aluminum Hard Hats

Forest Service Specification 177a for protective hats was changed recently to provide for an improved method for holding headlamp bands. The metal clips are much more durable and make for a better looking hat than the plastic loops formerly used.—ARTHUR W. JENSEN, *Forester, Division of Fire Control, U. S. Forest Service.*

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